NIST Handbook

NIST HB 44-2023

Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

*as adopted by the*

*107th National Conference on Weights and Measures*

Tina G. Butcher

Richard A. Harshman
Jan Konijnenburg

G. Diane Lee
Juana S. Williams

Lisa Warfield

Elizabeth J. Benham
Shelby L. Bowers

Katrice A. Lippa

This publication is available free of charge from:
<https://doi.org/10.6028/NIST.HB.44-2023>

|  |  |
| --- | --- |
| NIST Handbook | 44 |

2023 Edition

Supersedes NIST Handbook 44, 2022 Edition

NIST Handbook

NIST HB 44-2023

Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

*as adopted by the*

*107th National Conference on Weights and Measures*

Tina G. Butcher

Richard A. Harshman
Jan Konijnenburg

G. Diane Lee
Juana S. Williams

Lisa Warfield

Elizabeth J. Benham
Shelby L. Bowers

Katrice A. Lippa

*Physical Measurement Laboratory
Office of Weights and Measures*

This publication is available free of charge from:

<https://doi.org/10.6028/NIST.HB.44-2023>

November 2022



U.S. Department of Commerce

Gina M. Raimondo, Secretary

National Institute of Standards and Technology

Laurie E. Locascio, NIST Director and Under Secretary of Commerce for Standards and Technology

Certain commercial entities, equipment, or materials may be identified in this document in order to describe an experimental procedure or concept adequately. Such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the entities, materials, or equipment are necessarily the best available for the purpose.

This handbook conforms to the concept of primary use of SI (metric) measurements recommended in the Omnibus Trade and Competitiveness Act of 1988 by citing SI units before U.S. customary units where both units appear together and placing separate sections containing requirements in SI units before corresponding sections containing requirements in U.S. customary units. In some cases, however, trade practice is currently restricted to the use of U.S. customary units; therefore, some requirements in this handbook will continue to specify only U.S. customary units until a broad consensus is achieved on the permitted SI units.

In accord with NIST policy, the “meter” and “liter” spellings are used in this document. However, the “metre” and “litre” spellings are acceptable.

It should be noted that a space has been inserted instead of commas in all numerical values having four digits or more in this document. This follows a growing practice, originating in tabular work, to use spaces to separate large numbers into groups of three digits. This avoids conflict with the practice in many countries to use the comma as a decimal marker.

NIST Technical Series Policies

[Copyright, Fair Use, and Licensing Statements](https://doi.org/10.6028/NIST-TECHPUBS.CROSSMARK-POLICY), [NIST Technical Series Publication Identifier Syntax](https://www.nist.gov/nist-research-library/nist-technical-series-publications-author-instructions#pubid)

Publication History

Approved by the NIST Editorial Review Board on 2022-11-18
Supersedes NIST Handbook 44 - 2022 (November 2021) <https://doi.org/10.6028/NIST.HB.44-2022>

How to Cite this NIST Technical Series Publication

Butcher T, Harshman R, Konijnenburg J, Lee GD, Williams J, Warfield L, Benham E, Bowers S, and Lippa K (2022) Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Handbook (HB) NIST HB 44-2023. <https://doi.org/10.6028/NIST.HB.44-2023>

NIST Author ORCID iDs
T Butcher: 0000-0003-2711-9442
R Harshman: 0000-0001-9171-5906
J Konijnenburg: 0000-0003-2592-873X
GD Lee: 0000-0002-8005-0758
J Williams: 0000-0003-4807-9005
L Warfield: 0000-0003-0576-8572
E Benham: 0000-0002-2751-7881
S Bowers: 0000-0002-1902-362X
K Lippa: 0000-0001-8651-8326

Contact Information

owm@nist.gov
NIST Office of Weights and Measures

Attention: Publications Coordinator
100 Bureau Drive, MS 2600 Gaithersburg, MD 20899

Abstract

NIST Handbook 44 includes specifications, tolerances, and other technical requirements for weighing and measuring devices. These requirements are intended to encourage the design, installation, testing, and use of weighing and measuring devices that provide for accurate, repeatable measurements; facilitate clear and transparent transactions for buyer and seller; and do not facilitate fraud.

NIST Handbook 44 is adopted by many state, local, and some federal weights and measures authorities to apply to commercial weighing and measuring equipment and associated equipment and for use in applications for law enforcement and the collection of statistical information by government agencies.

NIST has a statutory responsibility for “cooperation with the states in securing uniformity of weights and measures laws and methods of inspection” and publishes this and other NIST Handbooks in partial fulfillment of this responsibility. NIST Handbook 44 was first published in 1949, having been preceded by similar handbooks of various designations and in several forms, beginning in 1918; the handbook is now typically published on an annual basis.

This 2023 edition includes amendments made through the Committee on Specifications and Tolerances of the National Conference on Weights and Measures (NCWM) with technical guidance from the Office of Weights and Measures (OWM) of the National Institute of Standards and Technology (NIST) and input from weights and measures officials and industry representatives. These amendments were adopted by the NCWM at its 107th Annual Meeting in July 2022.

**Keywords**

devices; dry measures; electric vehicle fueling systems; grain analyzers; grain moisture meters; hydrogen gas-measuring devices; liquid-measuring devices; LPG and anhydrous ammonia liquid-measuring; mass flow meters; measure-containers; measuring; measuring systems; meters; multiple dimension measuring devices; odometers; scales; taximeters; timing devices; transportation network measuring systems; vehicle tanks; weighing; weighing systems.

Foreword

NIST Handbook 44 was first published in 1949, having been preceded by similar handbooks of various designations and in several forms, beginning in 1918.

NIST Handbook 44 is typically published in its entirety each year following the Annual Meeting of the National Conference on Weights and Measures (NCWM). This handbook includes amendments endorsed by the 107th National Conference on Weights and Measures during its Annual Meetings in 2022.

This handbook conforms to the concept of primary use of SI (metric) measurements recommended in the Omnibus Trade and Competitiveness Act of 1988 by citing SI units before U.S. customary units where both units appear together and placing separate sections containing requirements in SI units before corresponding sections containing requirements in U.S. customary units. In some cases, however, trade practice is currently restricted to the use of U.S. customary units; therefore, some requirements in this handbook will continue to specify only U.S. customary units until a broad consensus is achieved on the permitted SI units.

In accord with NIST policy, the meter/liter spellings are used in this document. However, the metre/litre spellings are acceptable and are preferred.

It should be noted that a space has been inserted instead of commas in all numerical values greater than 999 in this document, following a growing practice, originating in tabular work, to use spaces to separate large numbers into groups of three digits. This avoids conflict with the practice in many countries to use the comma as a decimal marker.

Author Contributions

**Elizabeth J. Benham**: Writing - Original Draft, Writing - Reviewing and Editing; **Tina G. Butcher**: Data Curation, Writing - Original Draft, Writing - Reviewing and Editing; **Richard A. Harshman**: Data Curation, Writing - Original Draft, Writing - Reviewing and Editing; **Jan Konijnenburg**: Data Curation, Writing - Reviewing and Editing; **G. Diane Lee**: Writing - Original Draft, Data Curation, Writing - Reviewing and Editing; **Juana S. Williams**: Data Curation, Writing - Original Draft, Writing - Reviewing and Editing; **Lisa Warfield**: Writing - Reviewing and Editing; **Shelby L. Bowers**: Writing - Reviewing and Editing; **Katrice A. Lippa**: Supervision.

**Acknowledgments**

NIST OWM would like to thank Michael Dennis (NOAA), for his significant contributions to revise Appendices B and C to describe the retirement of the U.S. survey foot from the U.S. measurement system.

**Committee on Specifications and Tolerances of the 107th Conference**

Brad Bachelder, Maine

Jason Glass, Kentucky

Nick Owens, Stark County, Ohio

Jason Flint, New Jersey

David Aguayo, San Luis Obispo County, California
Louis Martinet, Measurement Canada, Technical Advisor

Richard Harshman, NIST Technical Advisor

G. Diane Lee, NIST Technical Advisor
Juana Williams, NIST Technical Advisor

Allen Katalinic, NCWM, NTEP Technical Advisor
Mike Manheim, NCWM, NTEP Technical Advisor

**Past Chairs of the Committee**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Conference** | **Chair** |  | **Conference** | **Chair** |
| 8-11 | L.A. Fischer, NBS |  | 76 | J. Truex, OH |
| 12-28 | F.S. Holbrook, NBS |  | 77-78 | C. Carroll, MA |
| 29-38 | J.P. McBride, MA |  | 79 | J. Jeffries, FL |
| 39-42 | R.E. Meek, IN |  | 80 | R. Suiter, NE |
| 43-44 | J.E. Brenton, CA |  | 81 | G. West, NM |
| 45-47 | C.L. Jackson, WI |  | 82-83 | R. Murdock, NC |
| 48 | T.C. Harris, VA |  | 84 | D. Brown, IA |
| 49-50 | R.E. Meek, IN |  | 85 | M. Hopper, CA |
| 51-52 | G.L. Johnson, KY |  | 86 | G. Shefcheck, OR |
| 53 | H.D. Robinson, ME |  | 87 | M. Coyne, MA |
| 54-55 | R. Rebuffo, NE |  | 88 | R. Wotthlie, MD |
| 56-57 | D.E. Konsoer, WI |  | 89  | C. VanBuren, MI |
| 58 | J.C. Mays, FL |  | 90 | J. Kane, MT |
| 59 | T.F. Brink, VT |  | 91 | C. Cooney, OR |
| 60 | W.S. Watson, CA |  | 92 | M. Sikula, NY |
| 61 | K.J. Simila, OR |  | 93 | C. Fulmer, SC |
| 62 | W.E. Czaia, MN |  | 94 | T. R. Lucas, OH |
| 63 | M.L. Kinlaw, NC |  | 95 | B. Saum, CA |
| 64 | J.A. Bird, NJ |  | 96-97 | S. Giguere, ME |
| 65 | D.A. Guensler, CA |  | 98 | K. Ramsburg, MD |
| 66 | G.A. Delano, MT |  | 99 | B. Gurney, UT |
| 67 | F.C. Nagele, MI |  | 100-101 | M. Albuquerque, CO |
| 68 | L.H. DeGrange, MD |  | 102 | M. Curran, FL |
| 69 | S.A. Colbrook, IL |  | 103 | I. Hankins, IA |
| 70 | D.A. Guensler, CA |  | 104 | R. Miller, WI |
| 71-72 | F. Gerk, NM |  | 105 | L. Minnich, KS |
| 73 | K. Butcher, MD |  | 106 | J. Nelson, OR |
| 74 | R. Andersen, NY |  | 107 | B. Bachelder, ME |
| 75 | D. Watson, TX |  |  |  |
|  |  |  |  |  |

THIS PAGE INTENTIONALLY LEFT BLANK

**Table of Contents**

 **Page**

Abstract i
Foreword ii

Author Contributions iii

Acknowledgments iv

2022 Amendments and Editorial Changes viii

Introduction 1

Section 1.

1.10. General Code 1-1

Section 2.

 2.20. Scales 2-1

 2.21. Belt-Conveyor Scale Systems 2-63

 2.22. Automatic Bulk Weighing Systems 2-81

 2.23. Weights 2-91

 2.24. Automatic Weighing Systems 2-99

2.25. Weigh-In-Motion Systems Used for Vehicle Enforcement Screening – Tentative Code 2-117

Section 3.

 3.30. Liquid-Measuring Devices 3-1

 3.31. Vehicle-Tank Meters 3-29

 3.32. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices 3-45

 3.33. Hydrocarbon Gas Vapor-Measuring Devices 3-63

 3.34. Cryogenic Liquid-Measuring Devices 3-75

 3.35. Milk Meters 3-87

 3.36. Water Meters 3-97

 3.37. Mass Flow Meters 3-107

 3.38. Carbon Dioxide Liquid-Measuring Devices 3-123

 3.39. Hydrogen Gas-Measuring Devices 3-139

 3.40. Electric Vehicle Fueling Systems 3-151

Section 4.

 4.40. Vehicle Tanks Used as Measures 4-1

 4.41. Liquid Measures 4-9

 4.42. Farm Milk Tanks 4-13

 4.43. Measure-Containers 4-21

 4.44. Graduates 4-27

 4.45. Dry Measures 4-33

 4.46. Berry Baskets and Boxes 4-39

Section 5.

 5.50. Fabric-Measuring Devices 5-1

 5.51. Wire- and Cordage-Measuring Devices 5-9

 5.52. Linear Measures 5-15

 5.53. Odometers 5-19

 5.54. Taximeters 5-25

 5.55. Timing Devices 5-39

 5.56.(a) Grain Moisture Meters 5-47

 5.56.(b) Grain Moisture Meters 5-61

 5.57. Near-Infrared Grain Analyzers 5-71

 5.58. Multiple Dimension Measuring Devices 5-83

**Table of Contents (continued)**

 **Page**

 5.59. Electronic Livestock, Meat, and Poultry Evaluation Systems and/or Devices 5-97

5.60. Transportation Network Measurement Systems – Tentative Code 5-101

Appendices

 A. Fundamental Considerations Associated with the Enforcement of Handbook 44 Codes A-1

 B. Units and Systems of Measurement - Their Origin, Development, and Present Status B-1

 C. General Tables of Units of Measurement C-1

 D. Definitions D-1